

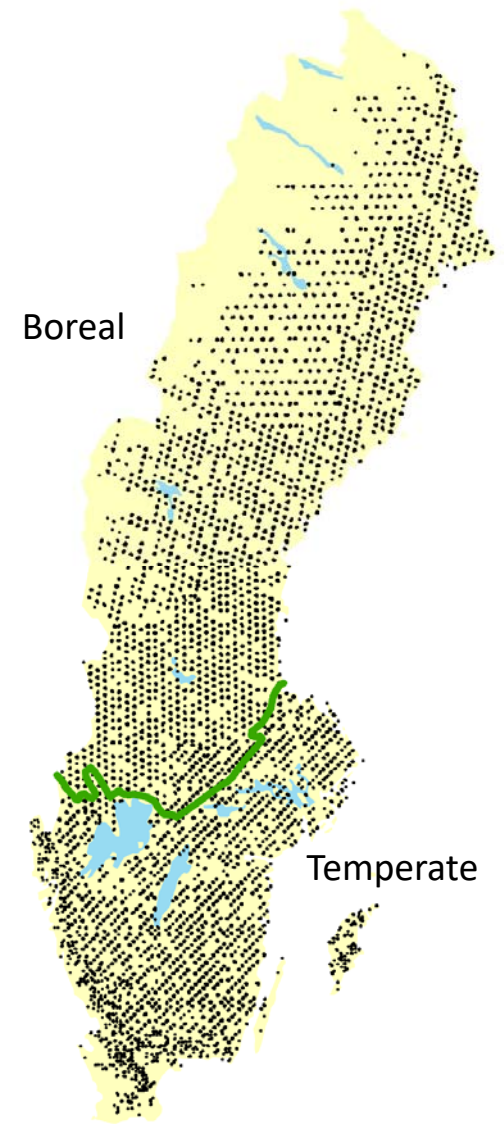
# Understorey movements in Swedish forests

Trends in forest floor vegetation and implications for forest management



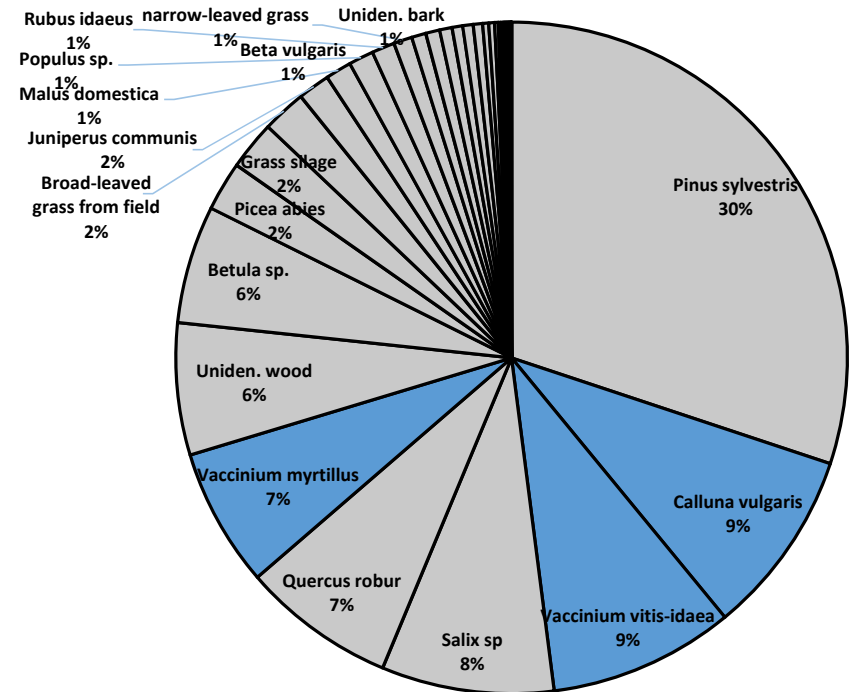
# Location and definitions

- Today's definition of forest floor vegetation: all herbaceous plants and woody plants (max height < 1 m)
- Dwarf-shrubs are low-growing woody plants e.g. bilberry, cowberry and heather
- National Forest Inventory (Riksskogstaxeringen)
  - Two NFI data sets
- Boreal and temperate
- Functional traits and indicator values
- Specific Leaf Area (SLA) is a measure of leaf thickness – higher SLA thinner leaves



# Why care?

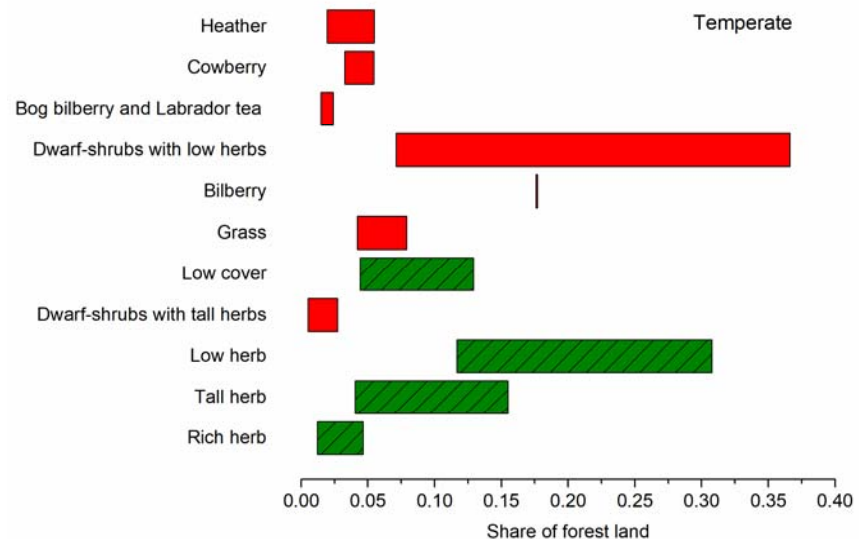
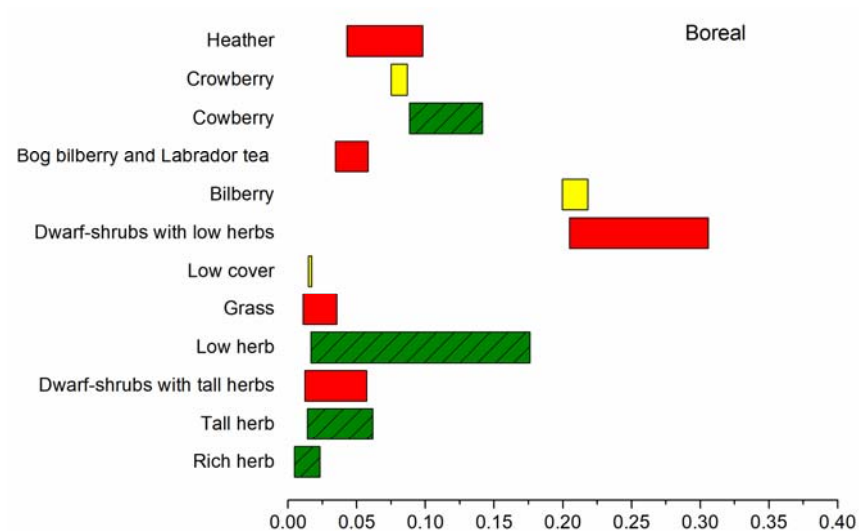
- Functionally important, e.g.
  - A food resource for animals ranging from invertebrates to moose and bears
  - Affecting nutrient and carbon cycles
- Ecosystem services, e.g.
  - Berries
  - Nutrient retention
  - Aesthetic amenities

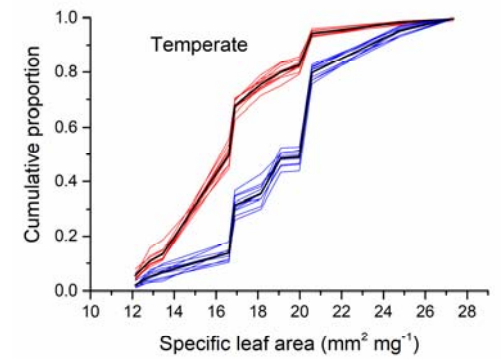
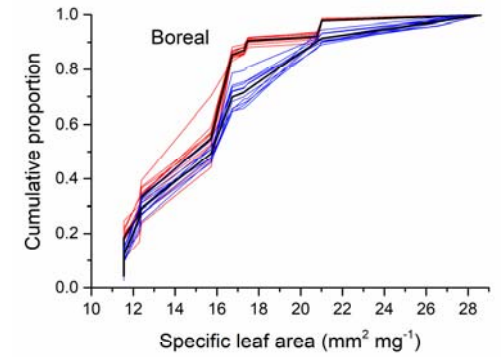
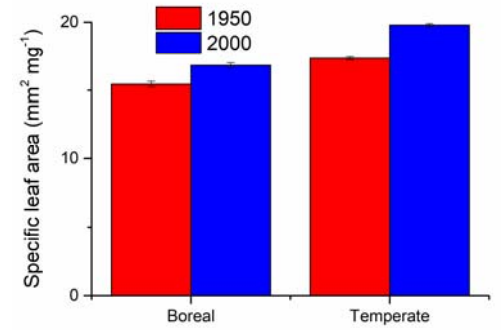
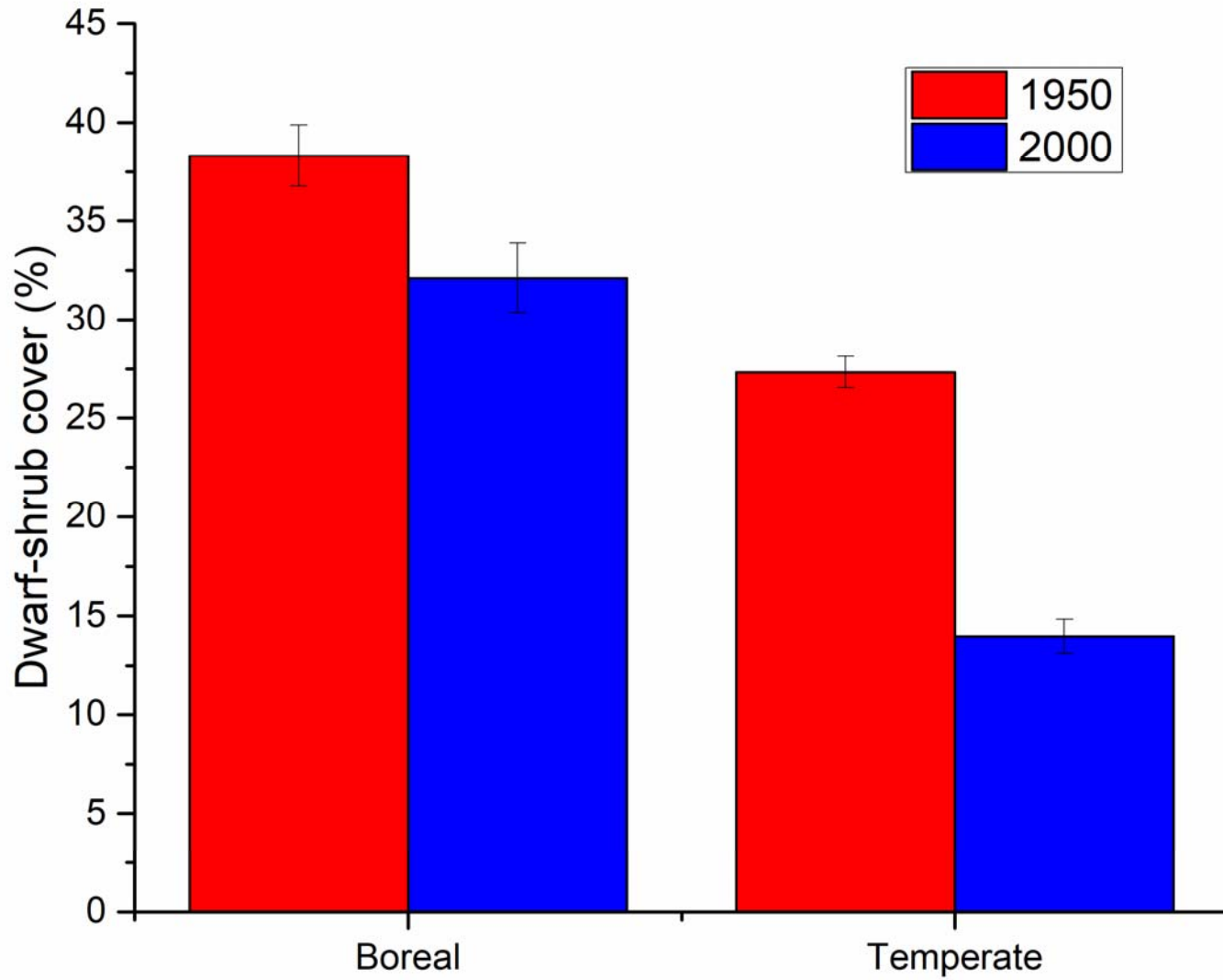


Felton, A. M. et al. in process. The value of a varied diet: Winter diet of free ranging moose (*Alces alces*) in relation to population condition in southern Sweden.

# Changes in vegetation types since the 1950s

- A decrease in dwarf-shrub types
- An increase in herb types and “low cover”
- The largest changes in “mixed” types
- A decrease in the disturbance favored grass type
- Similar direction of change in the south and north
- Larger changes in the south

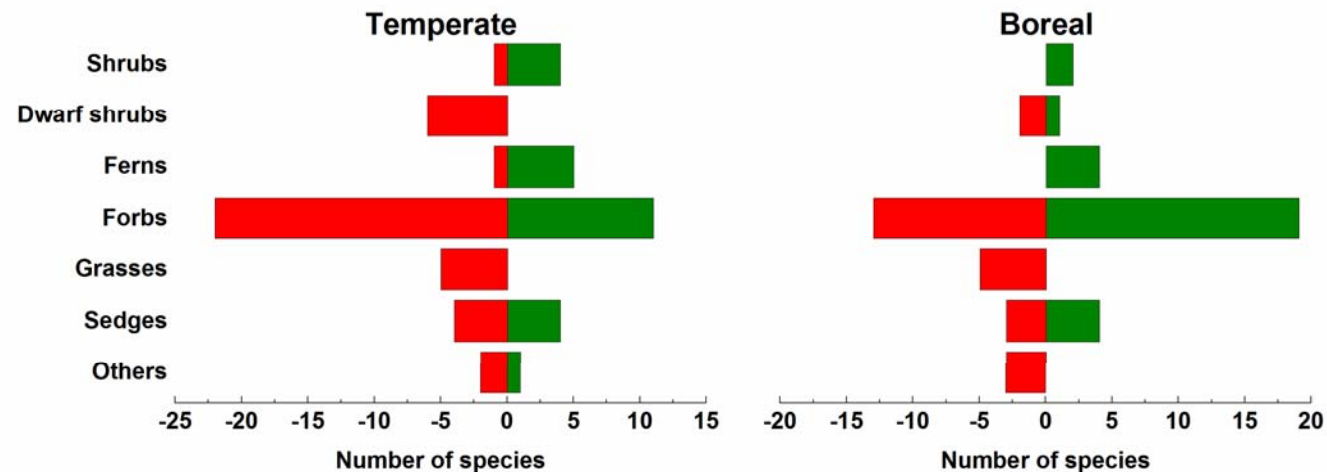




Hedwall et al. in process

# Changes in the Swedish understory vegetation during the last 20 years

- The most common 100 species
  - Boreal: 24 decreasing, 29 increasing
  - Temperate: 41 decreasing, 21 increasing



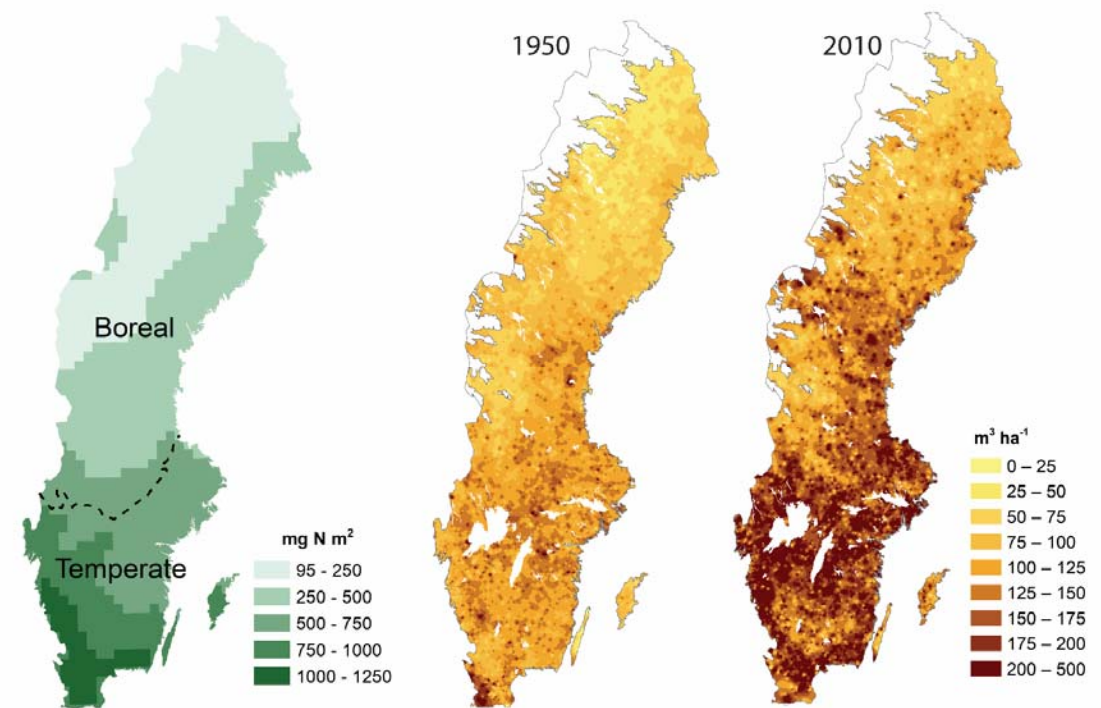
## Some clues from trait analyzes

- Increasing species were:
  - More adapted to shady conditions in both regions
  - More adapted to higher temperatures and nutrient availability in the south

Plant morphology		Leaf duration	Max height, cm	Leaf area	Pollination
Boreal	Trend	shorter	-	higher	-
	P-value	0.073	0.711	0.010	0.595
Temperate	Trend	shorter	higher	higher	more wind
	P-value	0.040	0.014	0.001	0.047
Macroclimate and soil conditions		Ellenberg K	Northern limit	Temperature sum optimum	Ellenberg N
Boreal	Trend	-	-	-	-
	P-value	0.218	0.190	0.272	0.101
Temperate	Trend	lower	less northern	higher	higher
	P-value	0.004	0.028	<0.001	0.001
Disturbance and light conditions		Seed bank	Ellenberg L	Grazing/mowing	Forest density niche width
Boreal	Trend	-	lower	-	-
	P-value	0.649	0.020	0.338	0.303
Temperate	Trend	more persistent	lower	less dependent	lower
	P-value	0.043	0.049	<0.001	0.008

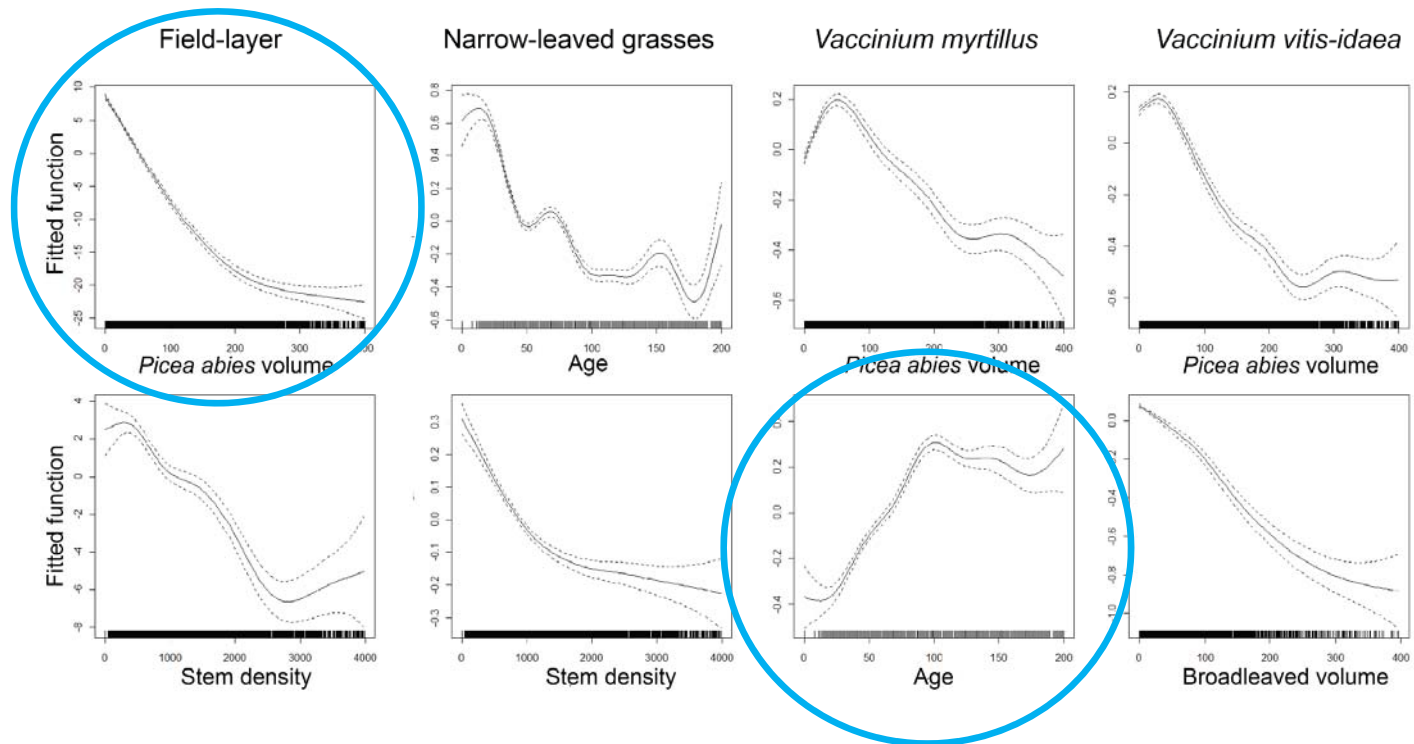
# Some processes may be more important than others...

- Increasing SLA is commonly considered to indicate two processes:
  - Increasing nitrogen availability, nitrogen deposition is higher in the south
  - Decreasing light availability, increase in timber volume
- Dwarf-shrubs are in general adapted to high light and low nutrient availability





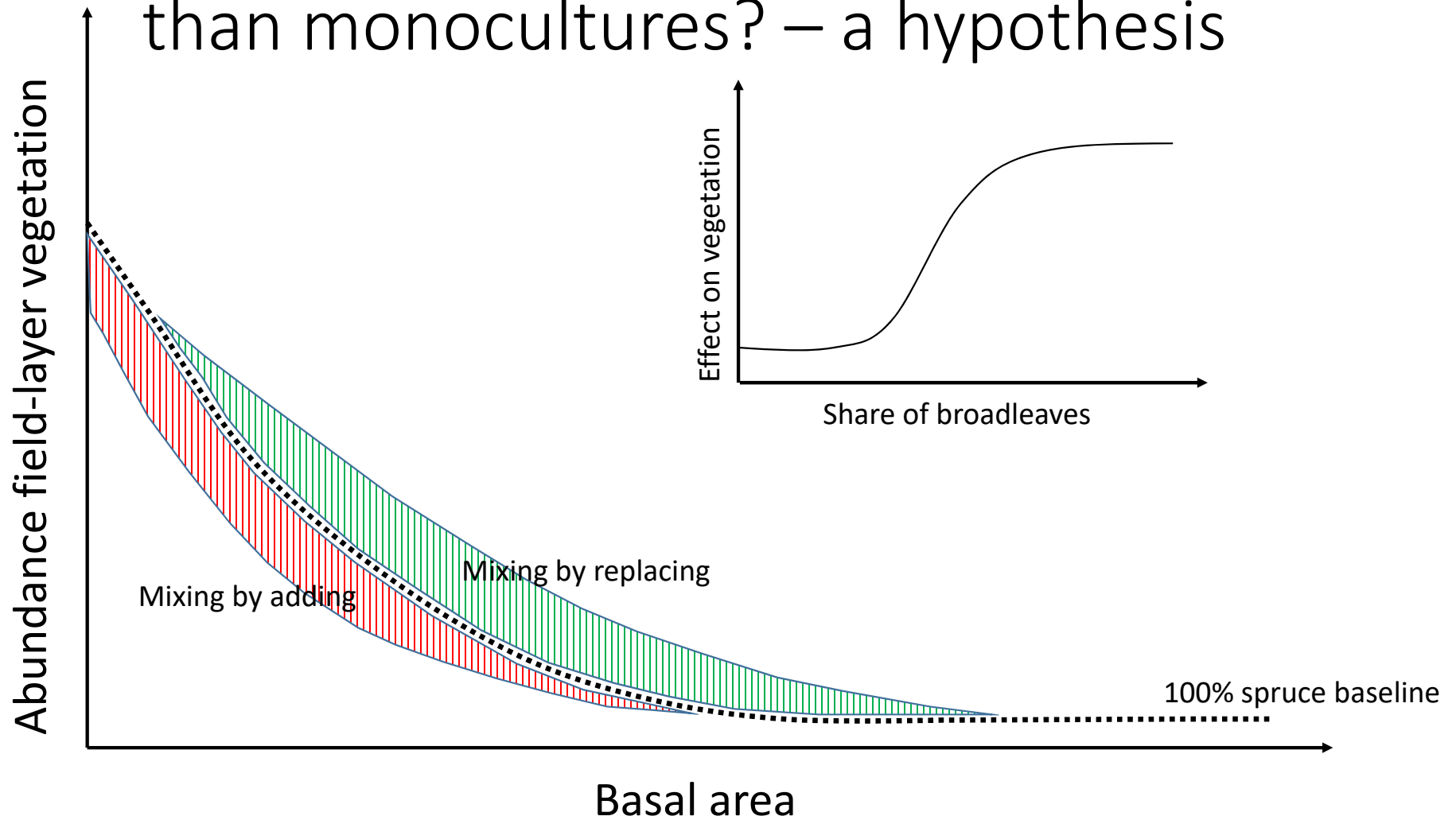
# Niche modelling



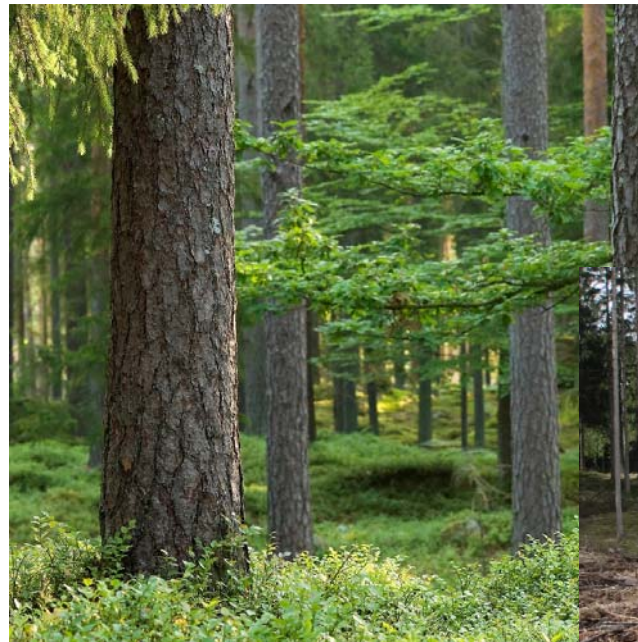
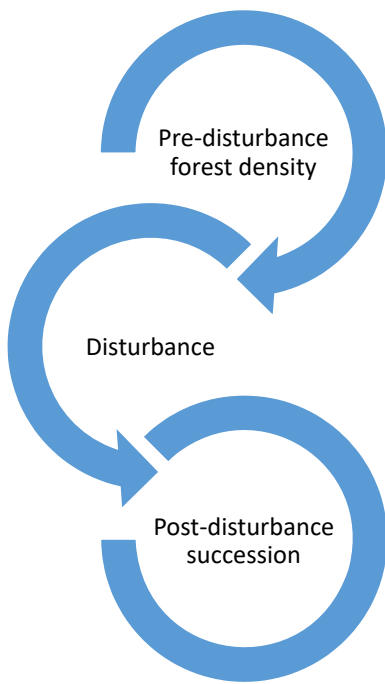
# Identification of some knowledge gaps

What can forest management do?

# Is mixed tree species composition different than monocultures? – a hypothesis



Do the negative effects of harvest on late successional species increase with increasing pre-harvest timber volume?



Thank you!